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Measuring Software Product Quality: the ISO 25000 Series and CMMI

European SEPG
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Objectives

Provide status on a new Software Product Quality Measurement standard and its connection to CMMI

Provide ideas on how to get started with Software Product Quality Measurement today

Outline

Background and Overview

Concepts and Models

Software Product Quality Measurement

Summary

Achieving Quality Software

Requires planning and intentional design

More than achieving the desired functionality

Must explicitly attend to both functional and non-functional requirements

Need to verify all requirements are being met throughout the life cycle

CMMI Definition for Quality Requirements

The phrase "quality and process-performance objectives" covers objectives and requirements for product quality, service quality, and process performance. Process performance objectives include product quality.

Requirements Development

This process area describes three types of requirements:
- **customer requirements (quality in use)**
- **product requirements (external quality attributes)**
- **product-component requirements (internal quality attributes)**

Taken together, these requirements address the needs of relevant stakeholders, including those pertinent to various product life-cycle phases (e.g., acceptance testing criteria) and product attributes (e.g., safety, reliability, maintainability).

Requirements also address constraints caused by the selection of design solutions (e.g., integration of commercial off-the-shelf products).

Requirements Development Goals

SG 1 **Develop Customer Requirements**
Stakeholder needs, expectations, constraints, and interfaces are collected and translated into customer requirements.

SG 2 **Develop Product Requirements**
Customer requirements are refined and elaborated to **develop product and product-component requirements***.*

SG 3 **Analyze and Validate Requirements**
The requirements are analyzed and validated, and a definition of required functionality is developed.

Process Management and Performance

The organization's process needs and objectives cover aspects that include the following:
- characteristics of the processes
- process performance objectives, such as time to market and product quality
- process effectiveness

A quantitatively managed process is institutionalized by doing the following:
- controlling the process using statistical and other quantitative techniques such that product quality, service quality, and process performance attributes are measurable and controlled throughout the project (internal and external quality measures and criteria)

Key Points in Relationship of CMMI and ISO 9126/25000 - 1

CMMI takes a total life cycle view and is inclusive in its approach to requirements development.

Requirements development explicitly seeks to have the developer consider quality requirements.

Project and Process Management processes explicitly consider product quality as process performance objectives.

Neither the standard nor CMMI endorses a uni-dimensional view of quality.

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Key Points in Relationship of CMMI and ISO 9126/25000 - 2

Product Quality Requirements are transformed into designs and implemented via the Technical Solution and Product Integration process areas.

The implementation of Product Quality Requirements are monitored and confirmed via the Project Management, Verification, and Validation process areas.

CMMI acknowledges the need for interaction and perhaps iteration among the related process areas to satisfactorily identify, specify, and address Product Quality Requirements.
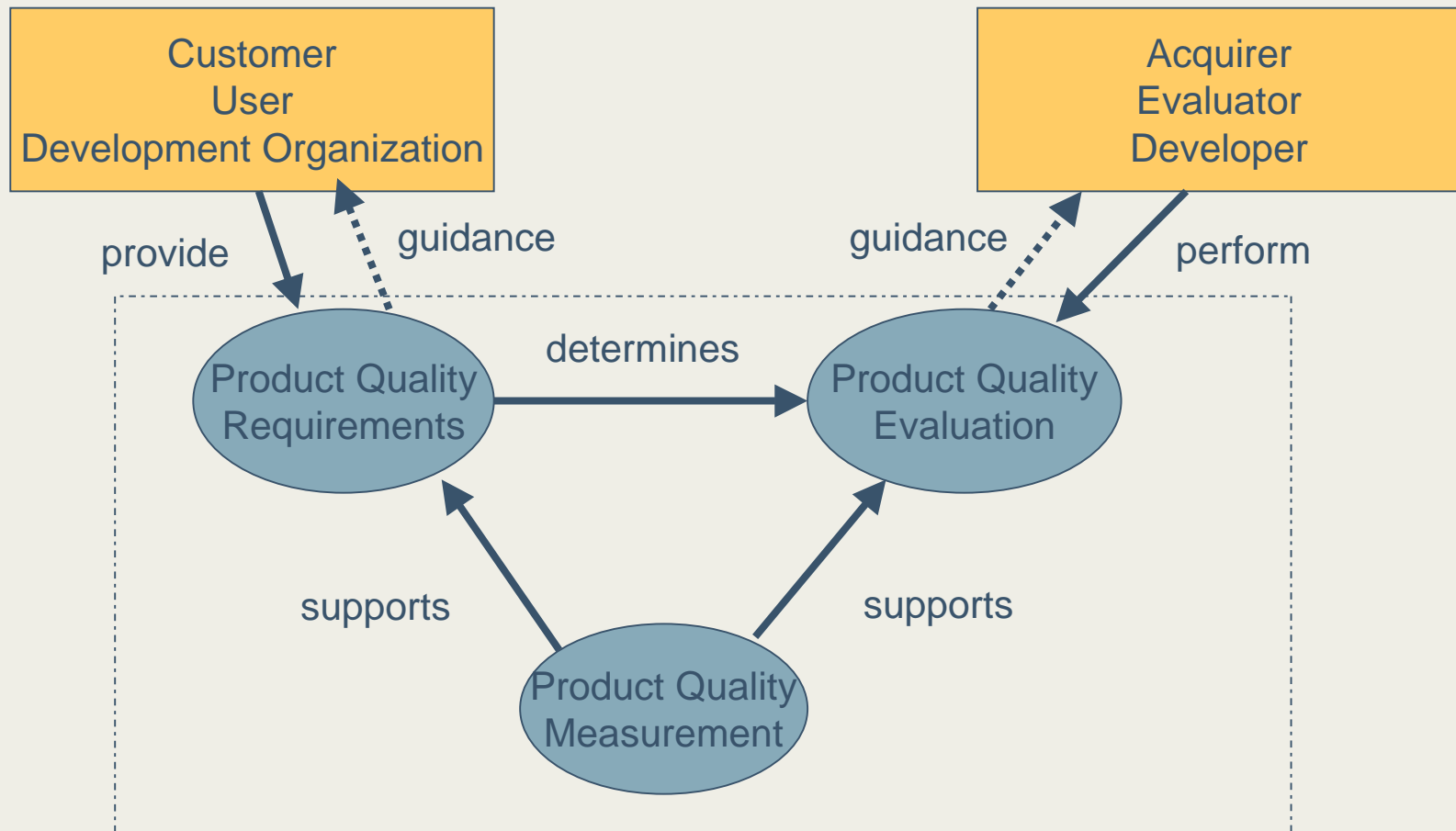
Outline

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Software Product Quality Measurement

Summary

SQuaRE: Architecture

ISO/IEC 2501n
Quality Model Division

ISO/IEC 2500n
Product Quality General Division

General Overview and Guide to the SQuaRE

Planning and Management

ISO/IEC 2503n
Quality Requirement Division

ISO/IEC 2504n
Quality Evaluation Division

ISO/IEC 2502n
Quality Metrics Division

Needs and Requirements

Stakeholders' Needs in their Minds Stated, Implied or Unaware Needs	**Solicit & Identify** →	Collected and Identified Stakeholders' (Business) Needs	**Select & Specify** →	Selected and Specified Needs & QIU Requirements

Functional Requirements → Functional Design & Internal Quality Requirements

External Quality Requirements → Non Functional Design & Internal Quality Requirements
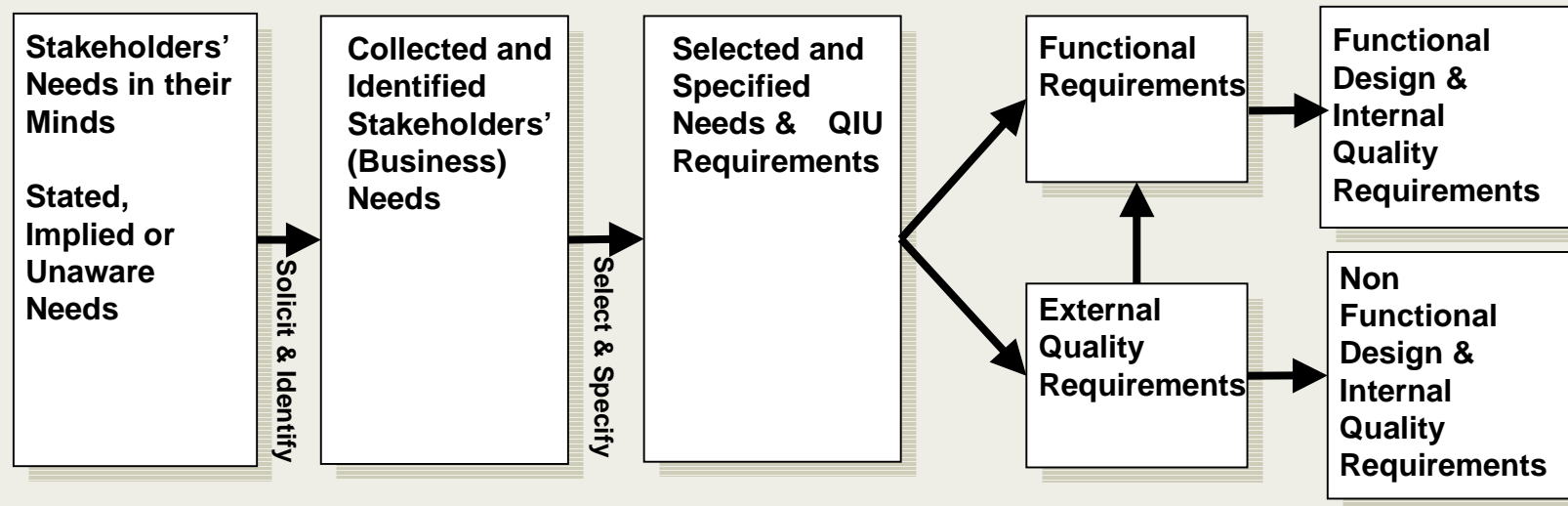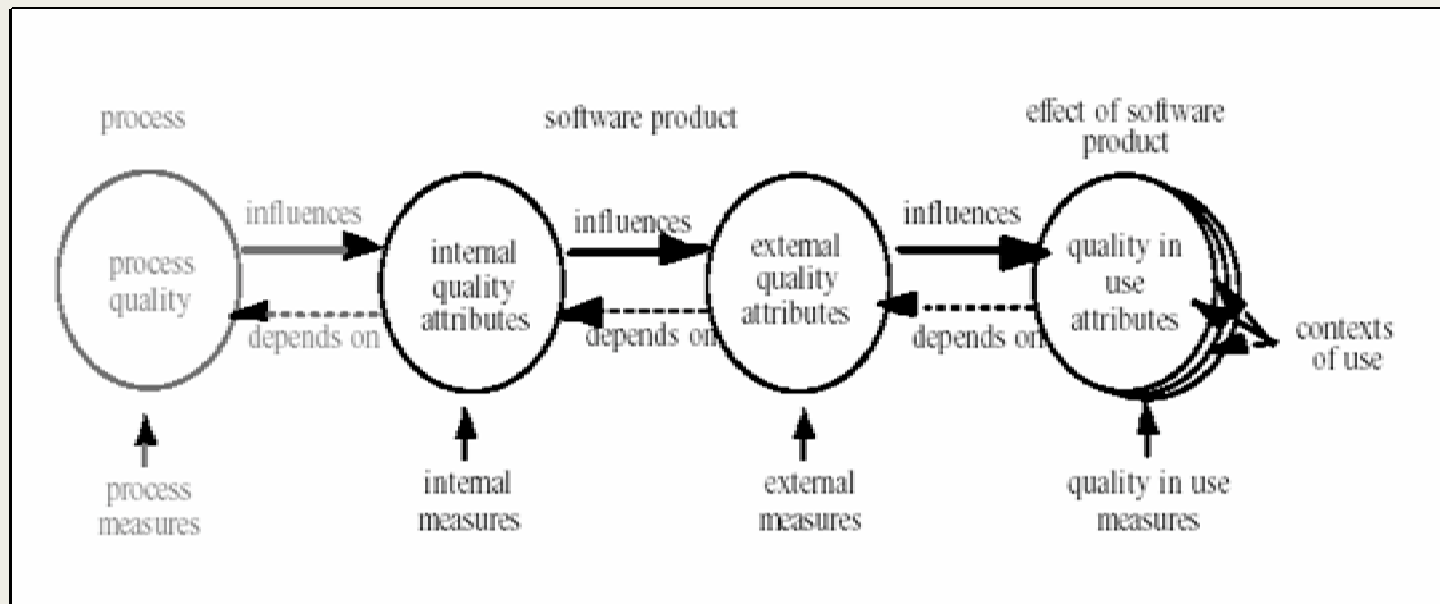
Internal and External Quality Requirements may be stated in coding standards, project quality goal statements, process descriptions (e.g., exit criteria), test case descriptions, etc. They need not be explicitly identified as requirements.
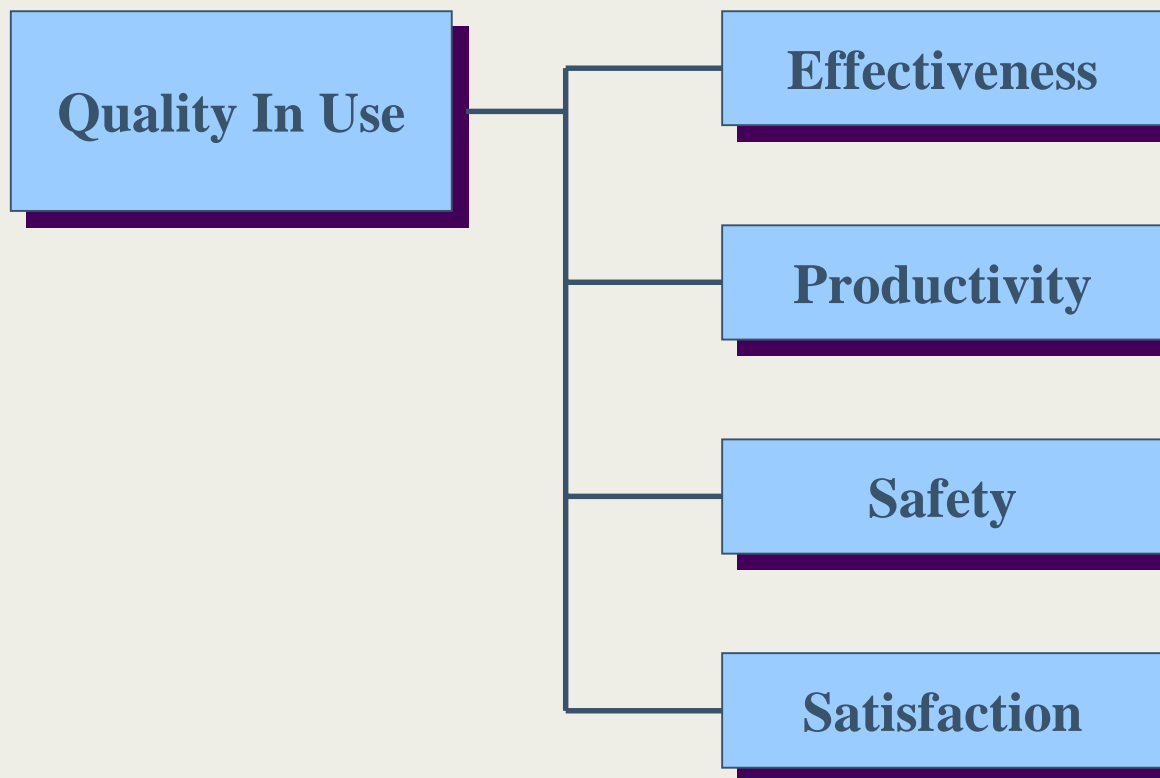
The Product Quality Measurement Reference Model

Internal and External Software Quality Model (ISO/IEC 9126)

Quality Characteristics   Subcharacteristics

•Functionality

| Suitability | Accuracy | Interoperability | Security | Compliance |

•Reliability

| Maturity | Fault tolerance | Recoverability | Compliance |

•Usability

| Understandability | Learnability | Operability | Comp | Attractiveness |

•Efficiency

| Time behavior | Resource utilization | Compliance |

•Maintainability

| Analyzability | Changeability | Stability | Testability | Compliance |

•Portability

| Adaptability | Installability | Co-existence | Replaceability | Comp |

Outline

Background and Overview

Concepts and Models

Software Product Quality Measurement

Summary

Quality Model Elements and Measurement Model Elements

Conceptual Model   Operationalization

| Characteristic | ← represents | Quality Measure |

comprise (↑)   One or more produce (↑)

| Subcharacteristic | ← represents | Quality Measure |

comprise (↑)   One or more produce (↑)

| Attribute | ← represents | Measurement Primitive |
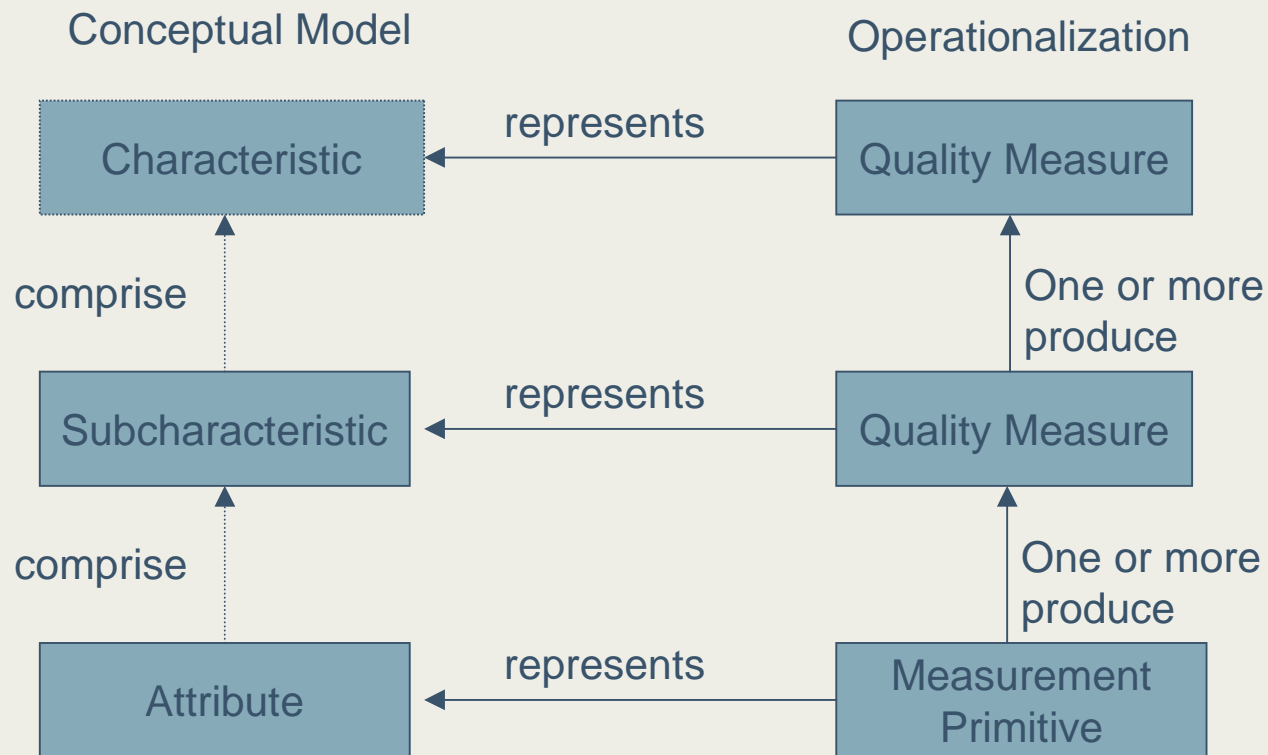
Relating the Quality and Measurement Models

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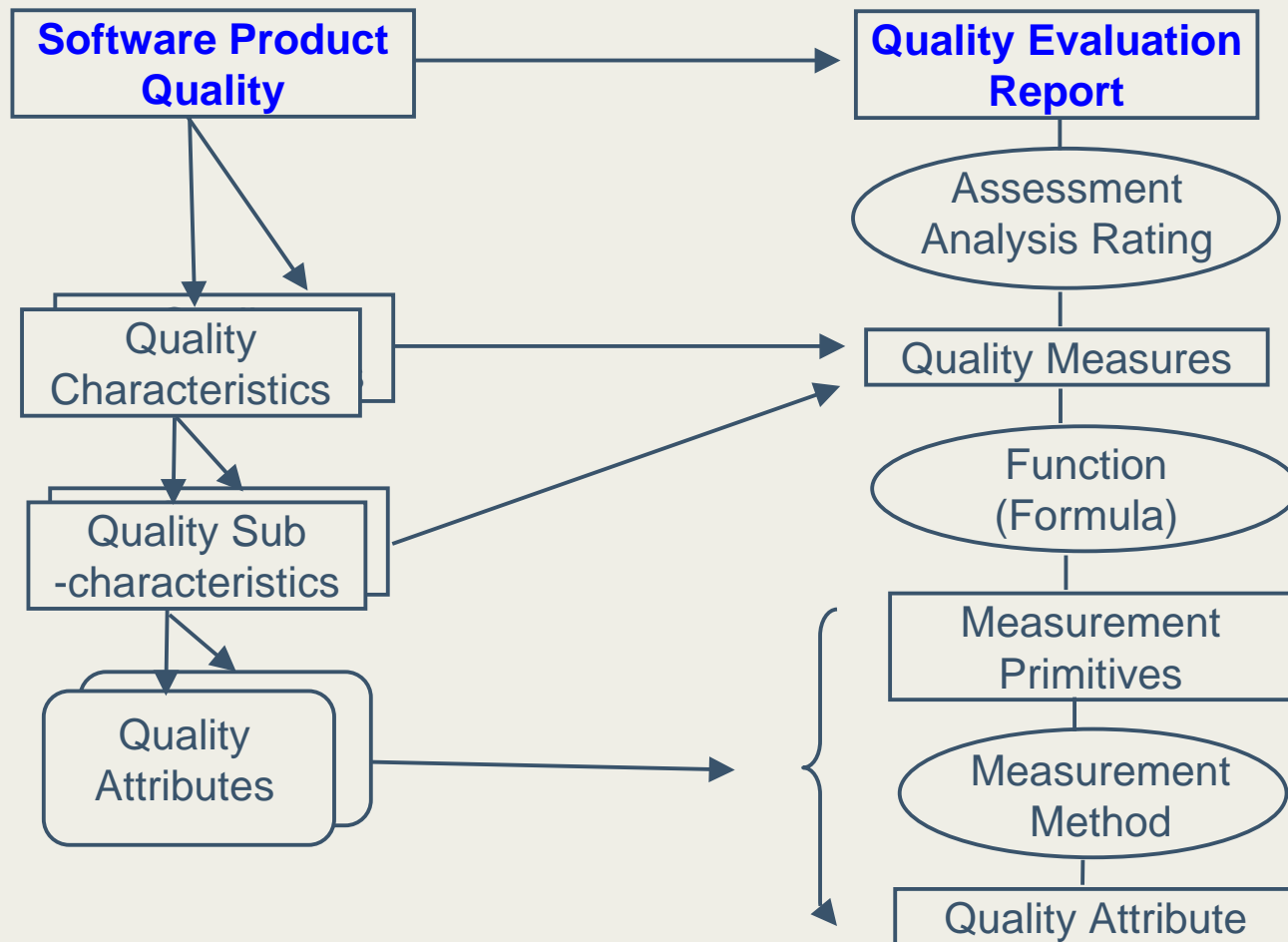
Relating the Quality Measurement Model to the ISO Software Measurement Process (15939)

Quality Evaluation Report

Assessment Analysis Rating

Quality Measures

Function (Formula)

Measurement Primitives

Measurement Method

Quality Attribute

Information Product

Interpretation

Indicator

Analysis Model

Derived Measures

Measurement Function

Base Measures

Measurement Method

Attribute

Analysis
25030
25040

Definition
&
Collection
2502n

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CMMI Measurement & Analysis Process Area Goals

Align Measurement and Analysis Activities

Provide Measurement Results

Institutionalize a Managed Process

Activities for Goal 1

Align Measurement and Analysis Activities
• Establish Measurement Objectives
• Specify Measures
• Specify Data Collection and Storage Procedures
• Specify Analysis Procedures

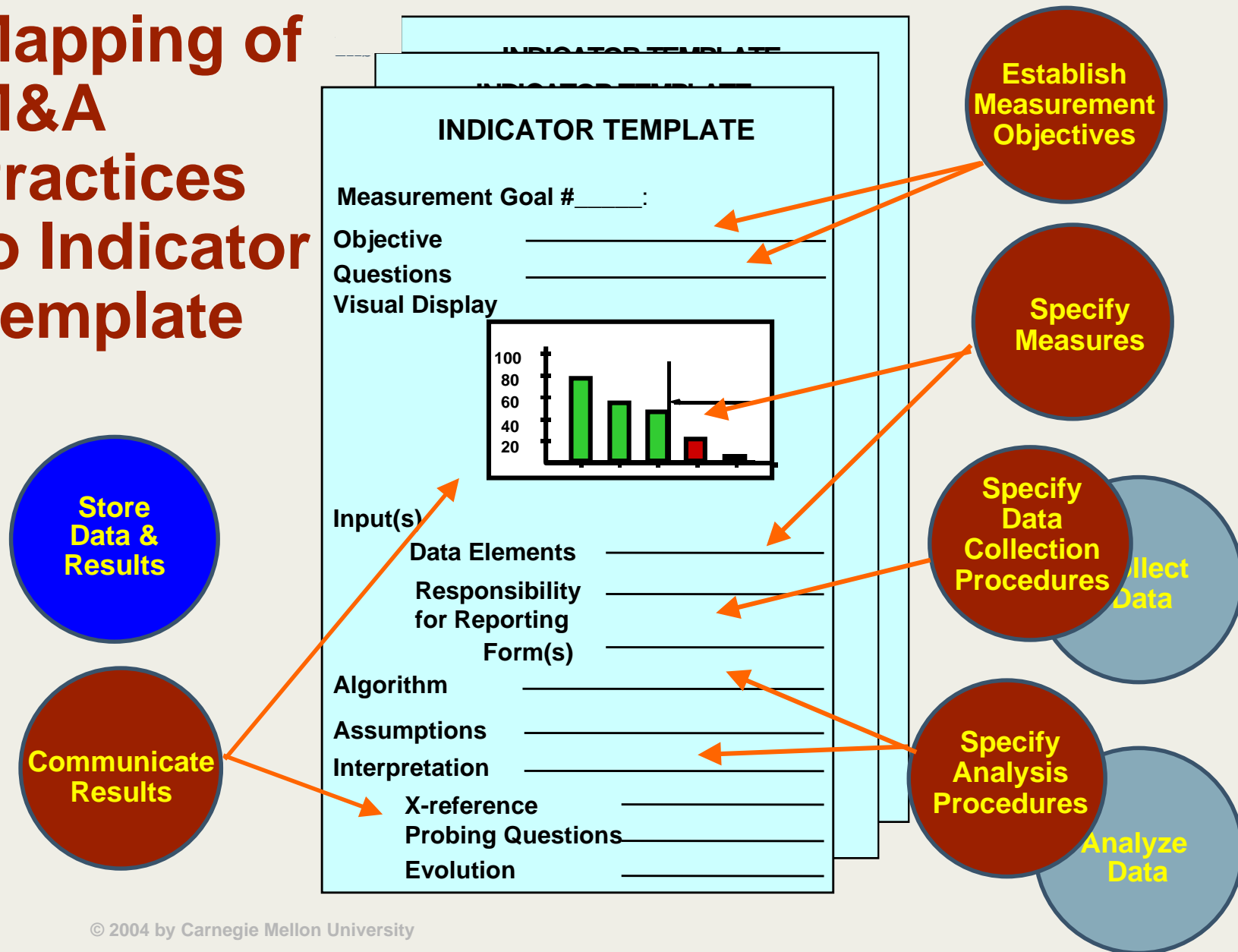Note: The first two practices directly address the need to translate from the conceptual to the operational.

Activities for Goal 2

Provide Measurement Results
- Collect Measurement Data
- Analyze Measurement Data
- Store Data and Results
- Communicate Results

Mapping of M&A Practices to Indicator Template

INDICATOR TEMPLATE

Measurement Goal #_____:

Objective _____

Questions _____

Visual Display

100
80
60
40
20

Input(s)

Data Elements _____

Responsibility for Reporting _____

Form(s) _____

Algorithm _____

Assumptions _____

Interpretation _____

X-reference _____

Probing Questions _____

Evolution _____

Establish Measurement Objectives

Specify Measures

Specify Data Collection Procedures

Collect Data

Specify Analysis Procedures

Analyze Data

Store Data & Results

Communicate Results

Measuring External Quality to Manage Software Development

Quality Characteristic/Subcharacteric: Efficiency/Time Behavior
Operational Measure: Response Time

Objective: Track satisfaction of user requirement for system response time.

Questions: What is the system response time with respect to common transaction? What is the variability in response time?
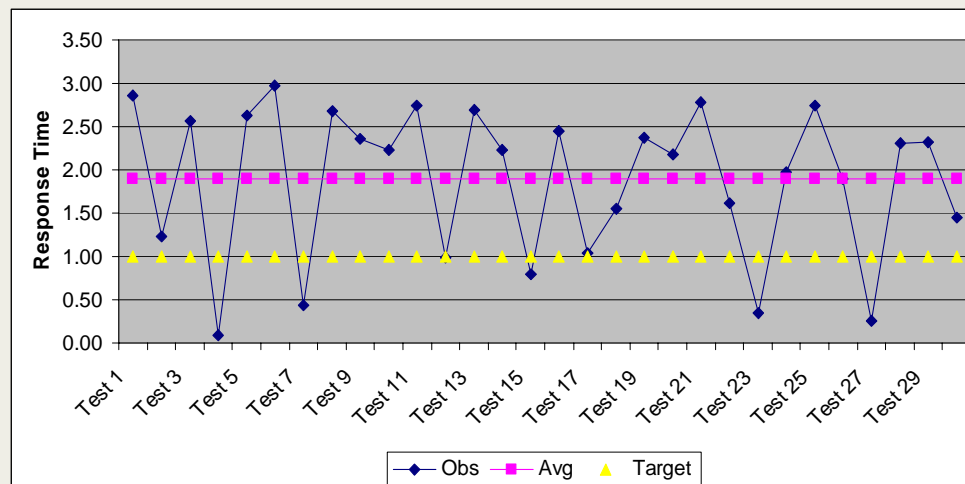
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Summary

Measurement links the specification of requirements to acceptance criteria

Quality is conceptual; measurement is operational.

GQ(I)M provides a means for moving from the conceptual to the operational.

The ISO 25000 series and the GQ(I)M Indicator Template together can help with your implementation of CMMI Requirements Development, Verification, and Validation.

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